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Characteristics and Development Report for Special Design Mechanical Parts in the W31Y1-2 to W31Y1-3 RM Kit

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CHARACTERISTICS AND DEVELOPMENT REPORT FOR SPECIAL DESIGN MECHANICAL PARTS IN THE W31Y1-2 to W31Y1-3 Retrofit Modification (RM) KIT

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Abstract

This report describes the design intent, the characteristics, and the test and development history for several new design mechanical parts used in the W31 Stockpile Improvement Program.

Forward

The design of the six mechanical parts covered in this report was a part of the overall design and development of the W31Y1-3 Warhead. That Stockpile Improvement Program upgrades nuclear safety and adds command and control features to the W31 Warhead. The design effort began in 1979 but, due to funding delays, was postponed and restarted in 1982. The first field retrofit kits were delivered in June 1985.

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INTRODUCTION

This report encompasses the characteristics and development history of the six special design mechanical parts required in the field retrofit material kit to support the W31Y1-2/W31Y1-3 Stockpile Improvement Program. Due to program funding delays, various design and development of these parts evolved over a period starting in 1979 and ending with the present concept in 1982. All items are the production responsibility of Allied Bendix Aerospace, and production processes they recommended have influenced design in some cases.

Items covered in this report are:

Pressure Cover Assy	370104
Safety Cover	370109
Protector Tube End Nut	370116
Protector Tube End Plug	370117
Plug, Guard	371685
Spacer	374383

PRESSURE COVER ASSEMBLY, P/N 370104-00

Design Intent

The new Pressure Cover Assembly, P/N 370104 (Figure 1), is made from an earlier model cover obtained from retirement of W31 warheads. Its primary purpose remains that of a pressure and humidity enclosure for the internal warhead components. Re-manufacturing operations at a Bendix supplier provide some new features, in addition to stripping the old paint and refinishing. A clamping bracket for the MC3761 and two new connector mounting holes are added. The manufacturing processes required are machining and pressure-tight aluminum welding. Proper surface finishes are required for sealing of preformed packings in next assemblies.

Component Characteristics

The original pressure cover is an aluminum, dome-shaped enclosure, approximately 18 inches high, 25 inches in diameter, and .125 inch thick. It has a heavy, circular flange, welded or riveted to the top, for mounting the Nike-Hercules cartridge assembly, and a base flange at the open end, for attachment to the polar cap of the warhead. There is a single, large hole at the top center for a connector and mounting features for a pressure valve on the top outer diameter.

The re-manufacturing process adds provisions for mounting two new connectors in the vicinity of the existing pressure valve. Twin, circular clamp brackets are welded to the cover for holding the MC3761.

The most important aspects of the process are proper fixturing for machining and locating the new features, proper techniques for leak-proof welding, and acceptable methods for application of the protective finish.

Test and Evaluation

Characteristics of the pressure cover assembly subject to test and evaluation were 1) its interface mounting features; 2) its pressure integrity; 3) location of newly added features to assure their accessibility in the final missile assembly; and 4) quality of the protective coatings.

Each characteristic was addressed as follows:

1. Interface mounting was acceptable initially by actual functional assembly in the previous application of the unmodified covers. The mounting hole patterns are re-certified as part of the re-manufacturing process. The threaded inserts are inspected and replaced if necessary. Several trial assemblies were made at Bendix during the Retrofit Kit TMS evaluations. A small number of retirement covers have not passed the pre-process inspection due to damage during shipment or storage. Those units were discarded.

2. The pressure integrity is assured by 100% final acceptance inspection, using appropriate test fixtures and leak detection equipment. Six units have been processed through the assembly steps and the trans-shipment required for incorporation into missiles and test firing, with no leaks detected.

3. Functional assembly tests in the development laboratory and application in the above mentioned flight tests have proved the accessibility of the newly added features in the final assembly environment.

4. Paint stripping and quality recoating are the result of developing satisfactory processes at the Bendix supplier's plant.

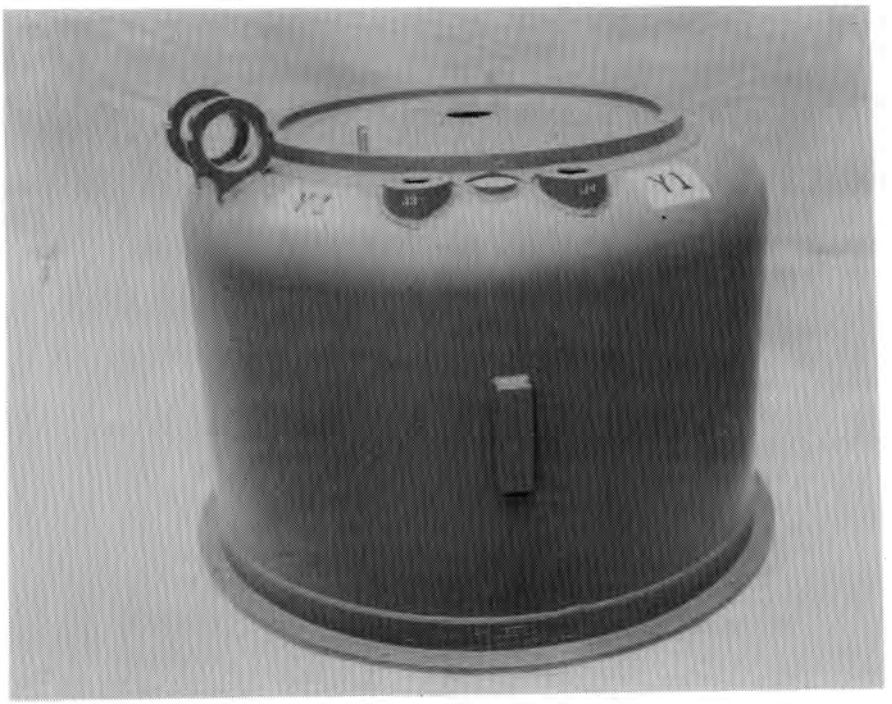
Development History

The basic design concept for the Stockpile Improvement of the W31 included requirements for a PAL device and a method to provide a unique signal to drive an MC2935 Strong-Link switch.

The PAL device required a connector on the pressure cover for control access.

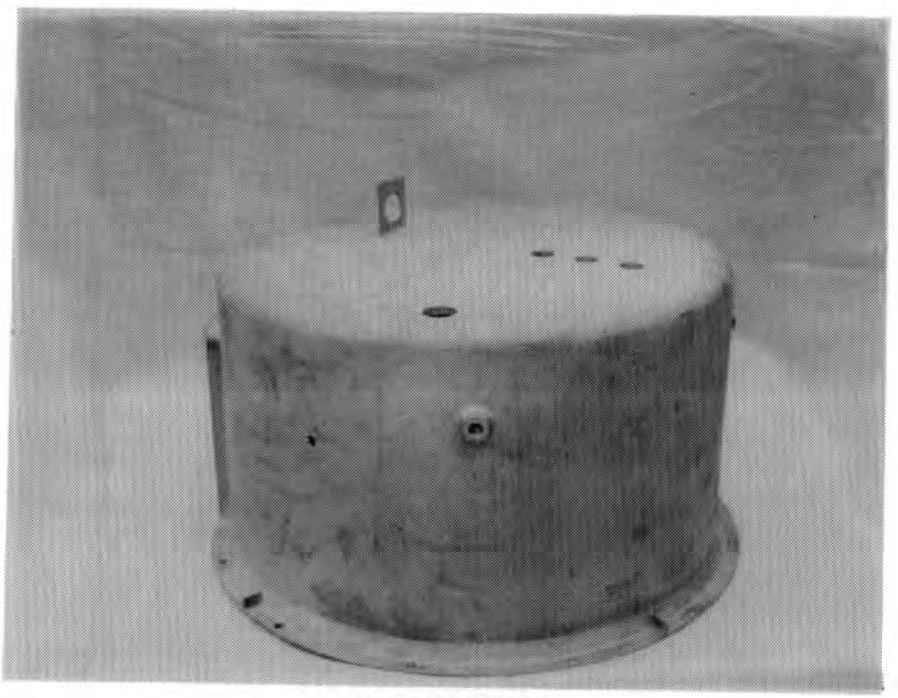
The possibility of adding the unique signal generation capability to the launch control console was an option in the early stages of the design but was subsequently discarded because of its complexity. Mounting the MC3761 Unique Signal Generator on the outside surface of the pressure cover, with a connector through the cover, allowed the above option as a possibility during the early design. In the final design it allows the use of a guard plug to electrically isolate the unique signal from the system. The Guard Plug is located so that it may be readily removed when launch is imminent.

The final result was the addition of two connector mounting holes and a twin clamp bracket mounting for the MC3761 Unique Signal Generator to the Pressure Cover.



Pressure Cover Assembly

Figure 1



Safety Cover

Figure 2

SAFETY COVER, P/N 370109

Design Intent

The new Safety Cover, P/N370109 (Figure 2), was designed to provide a high-strength steel cover for the warhead electrical system and to duplicate the weight and CG of parts removed from the W31 during the field modification.

Component Characteristics

The Safety Cover is a cylindrical cover with one open end. It is approximately 22 inches in diameter and 13 inches long, with a 24-inch diameter mounting flange at the open end. The cylindrical wall thickness is a nominal .120 inch, and the thickness of the flat, closed end is .280 inch. This configuration establishes the important weight (62.058 lbs) and CG characteristics, closely matching those of the parts discarded in the retrofit.

There is a 23-1/2 inch diameter bolt hole circle on the mounting flange, and three one-inch diameter holes in the flat end. There are four bosses on radial lines, which carry 1/2-20 UNF.2B threaded holes (for lifting handles). A 2-1/2-inch x 2-inch flat plate is welded normal to the outer surface of the flat end, with a 1.265-inch diameter "D" to mount a connector. There is a rectangular "pocket" 2.760 inches wide, 9.75 inches long, with a 11.91-inch radius formed on the side. A 1.265 diameter "D" hole in the flat end provides a location for the Lightning Arrestor Connector.

The part is unique because it was produced using the investment casting process and is of very large proportions for this method. The material is steel alloy 17-4PH (stainless) and is heat treated to 1100°F, which results in a tensile strength of approximately 150,000 psi.

A wax pattern is molded in an aluminum mold. The pattern is coated with successive layers of ceramic slurry and sand and then fired. The ceramic hardens, and the wax melts out. Then the molten metal is poured into the pre-heated ceramic mold. The mold is broken away from the solidified part. Gates and sprues are cut away. The part is hot straightened in large presses with properly shaped tools. Interestingly, over 400 pounds of metal are poured (in a vacuum chamber) to produce a 62-pound part. This is necessary in order to keep the hot metal flowing into the thin-walled section.

Each safety cover is sand blasted clean and passivated. Unfortunately, this process results in uneven coloration, with dark spots and sometimes brown areas in the otherwise grey satin-like finish, typical of sand-blasted steel. It has been decided that the discoloration does not degrade the part and is preferable to including a large area of organic coating within the desiccated area of the warhead.

Test and Evaluation

The Safety Cover is a passive structure. In addition to the foundry control castings routine and metallurgy analysis at Bendix, several trial assemblies have been made to next assembly hardware. These functional checks have resulted in improved inspection and gaging for field interchangeability.

Safety Covers incorporated in the six development flight test units functioned satisfactorily.

Further fire tests and fragment penetration tests are planned on major assemblies to determine more precisely what the Safety Cover contributes in resistance to abnormal environments.

Development History

The initial concept for the safety cover was a welded design. Early prototypes were weldments. Production engineers at Bendix were convincing in their arguments for the economy of a casting. The investment casting process for a part this large and of thin and thick wall configuration was not routine in the industry.

The chosen supplier, Vestshell of Montreal, Canada, was willing to undertake the job and has proved to be capable.

Some difficulty was encountered with the interface hole pattern, apparently resulting from a tooling difficulty. The gage design was reviewed and improved to assure interchangeability in the field. The tooling also was improved.

Cleaning by sand blast and passivation of the part had to be emphasized to the supplier. Early production parts were cleaned and re-passivated at Bendix because of their unacceptable appearance.

PROTECTOR, TUBE END NUT AND PLUG, P/N 370116 AND P/N 370117

Design Intent

The W31 Stockpile Improvement field retrofit, the dummy reservoir, which normally retains,the end of the gas fill tube, is discarded. The protector, tube end nut and the mating plug serve to hold and protect the fill tube in the modified assembly.

The Nut P/N 370116 (Figure 3) fits the gland nut on the fill tube and captivates it in a bracket on the periphery of the MC3777 Firing Set.

The Plug P/N 370117 (Figure 3) is configured to fit the ferrule on the gas tube and hold it in place, while protecting the closed end of the tube.

Component Characteristics

The Protector Tube End Nut is a nominal 3/4-inch hex nut, 7/8 inch long. It has a 9/16 - 18 UNF-3A internal thread. Material is 303 alloy steel (stainless), and it is passivated.

The Protector Tube End Plug is a 9/16-inch diameter cylinder, threaded 9/16 18 UNF-3A its full length of 3/4 inch. It has a nominal 3/16-inch diameter hole through the center and a screwdriver slot in one end. Material is 303 alloy steel (stainless), and it is passivated.

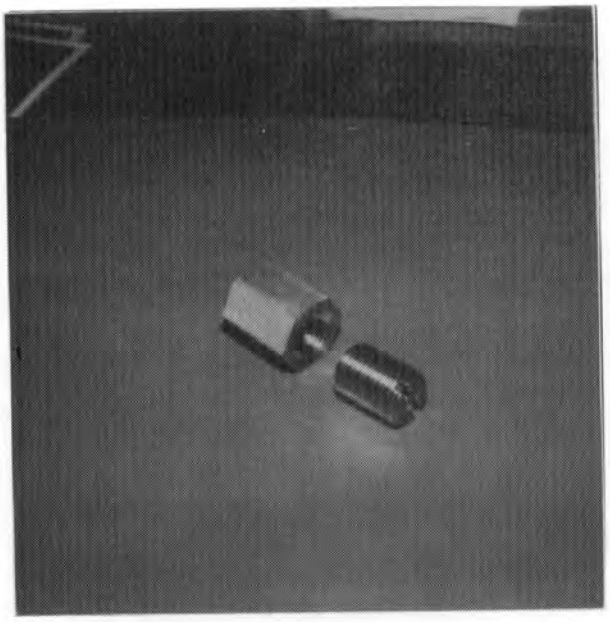
Test and Evaluation

These parts have been functionally evaluated in a large number of development assemblies.

Development History

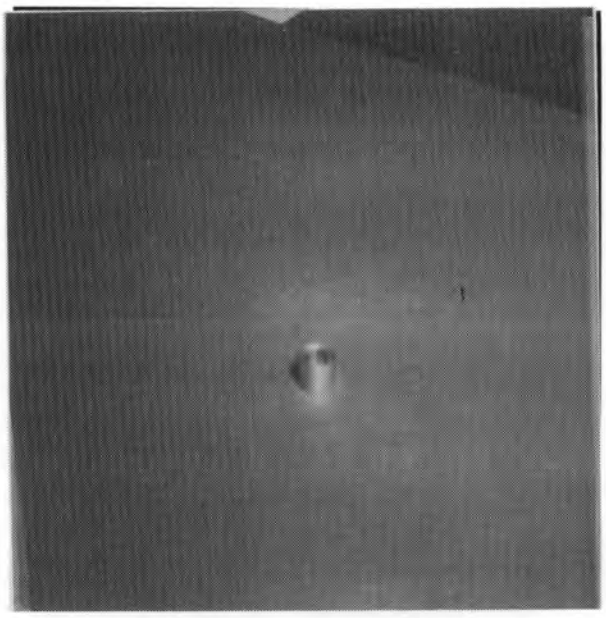
As a result of functional evaluation during several assembly operations, the design has been evolved, and by adding chamfers and clearance features, function and assembly have been improved.

These items are produced in-plant at Bendix, Kansas City.



Protector Tube End Nut and Plug

Figure 3



Spacer

Figure 4

SPACER P/N 374383

Design Intent

The Spacer, P/N 374383 (Figure 4), was designed so that the same length bolts could be used for all eight holes of the bolt circle which attaches the MC3777 Firing Set to the forward polar cap.

Five of the eight bolts require spacers. Unfortunately there is a space adjacent to each of the five holes, where common flat washers could slip irretrievably inside the MC3775 enclosure during field assembly. The spacer is too large to enter the enclosure.

Component Characteristics

The Spacer is an anodized aluminum cylinder, a nominal 5/16 inch long and 3/8 inch in diameter, with a 13/64-inch diameter hole through the center.

Test and Evaluation

The Spacer has been evaluated through several successful development assemblies and six flight tests.

Development History

The need for a spacer was discovered during early development assemblies. The eight bolts involved are difficult to install because of obstruction by adjacent parts. More or less fumbling flat washers into position resulted in many of them slipping inside the MC3775 enclosure. Installation of the bolts is a field retrofit operation, and the field is not permitted to disassemble the enclosure to retrieve such washers.

The Spacer is a screw machine part made in the Bendix plant.

PLUG, GUARD, P/N 371685

Design Intent

The prime purpose of the Guard Plug, P/N 371685 (Figure 5), is to provide a removable steel barrier covering the unique signal input connect to the the warhead. A secondary purpose is to provide a convenient storage location for the MC3761 (Unique Signal Generator) pigtail connector, when not connected directly to the warhead circuits. There is an electrical monitor loop in the Guard Plug connector, which remotely indicates the presence of the device when it is in place.

Component Characteristics

The Guard Plug is an LJT06T-13-98P connector, with an alloy steel connector shell-like extension screwed and pinned to the threads normally used for a potting mold. There is a steel wall (bottom) in the extrusion, which covers the solder cups in the connector. The open end of the extrusion is configured to mate the LJT06T-13-98P connector on the MC3761 pigtail, but there is no mating insert or sockets. The open end incorporates the five keyway slots and the tri-lock pins.

The name "GUARD PLUG" is lettered around the mid-section of the circumference of the device.

Test and Evaluation

The Guard Plug has been functionally evaluated in a number of development test assemblies and proved to perform as required. A 100% test for continuity of the test loop is required in production.

Development History

Due to a misquote of cost and delivery by Bendix Electrical Components Division (BECD), the initial design was for an alloy steel assembly, including the body of the LJT06T-13-98P. When an order was negotiated with BECD, they discovered their error, and the price and delivery escalated out of practical limits. The final design incorporates a standard anodized aluminum connector, joined to an alloy steel special design extrusion. The alloy steel barrier is retained.

Protector Tube End Nut

Figure 5

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